

PCT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C. 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 19 October 2000 (19.10.00)	
International application No. PCT/GB00/00809	Applicant's or agent's file reference P/61767/VISD
International filing date (day/month/year) 06 March 2000 (06.03.00)	Priority date (day/month/year) 05 March 1999 (05.03.99)
Applicant PIKE, Andrew	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

22 September 2000 (22.09.00)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer S. Mafla Telephone No.: (41-22) 338.83.38
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P/61767/VISD	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 00809	International filing date (day/month/year) 06/03/2000	(Earliest) Priority Date (day/month/year) 05/03/1999
Applicant MARCONI APPLIED TECHNOLOGIES LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of Invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT



International Application No.

PCT/IB 00/00809

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 GOIN33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 GOIN

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 025 653 A (SCHULDT HANS P) 25 June 1991 (1991-06-25) column 1, line 5 - line 21 column 5, line 20 - line 47 column 6, line 4 - line 42 column 7, line 54 - line 57 column 8, line 1 - line 5	1, 4-6, 8, 16, 24
Y	claim 1 ----- -/--	9, 15, 17, 18

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

6 June 2000

Date of mailing of the international search report

15/06/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Stussi, E

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/00809

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	J. MITROVICS ET AL.: "Hybrid Modular Sensor System: a New Generation of Electronic Noses" IEEE INT. SYMPOSIUM ON INDUSTRIAL ELECTRONICS, vol. 1, 7 - 11 July 1997, pages 116-121, XP000887386 Guimaraes (Portugal) the whole document	1,9,15, 17,18
Y	GB 1 401 566 A (KNEER F) 16 July 1975 (1975-07-16) page 3, column 27 -column 29	1
Y	US 5 131 746 A (PRATHER WILLIAM S ET AL) 21 July 1992 (1992-07-21) column 1, line 60 -column 2, line 3	1,15
Y	ULMER H ET AL: "Odours and flavours identified with hybrid modular sensor systems" SENSORS AND ACTUATORS B,CH,ELSEVIER SEQUOIA S.A., LAUSANNE, vol. 43, no. 1-3, 1 September 1997 (1997-09-01), pages 24-33, XP004103421 ISSN: 0925-4005 the whole document	1,9,15, 17,18
A	EP 0 501 682 A (ARCHER DANIELS MIDLAND CO) 2 September 1992 (1992-09-02) the whole document	1-25
A	GOEPEL W: "CHEMOSENSOREN MIT ELEKTRISCHEN TRANSDUCERN" TECHNISCHES MESSEN TM,DE,R.OLDENBOURG VERLAG. MUNCHEN, vol. 62, no. 5, 1 May 1995 (1995-05-01), pages 186-197, XP000533425 ISSN: 0171-8096 the whole document	1-25
A	EP 0 696 005 A (FLUKE CORP) 7 February 1996 (1996-02-07) the whole document	1-25

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/00809

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5025653	A	25-06-1991	DE 3819128 C	14-12-1989
			EP 0345568 A	13-12-1989
			JP 2085752 A	27-03-1990
			JP 2909096 B	23-06-1999
<hr/>				
GB 1401566	A	16-07-1975	DE 2253009 A	09-05-1974
			DE 2318978 A	24-10-1974
			AT 324365 B	25-08-1975
			AU 476969 B	07-10-1976
			AU 6160173 A	24-04-1975
			BE 830278 A	16-10-1975
			CA 1011473 A	31-05-1977
			CH 564495 A	31-07-1975
			DD 107429 A	05-08-1974
			DK 134750 B	10-01-1977
			ES 419950 A	16-04-1976
			FI 54469 B	31-08-1978
			FR 2204592 A	24-05-1974
			HU 167469 B	28-10-1975
			IT 998989 B	20-02-1976
			JP 1104972 C	16-07-1982
			JP 49131854 A	18-12-1974
			JP 56048469 B	16-11-1981
			NO 139638 B	08-01-1979
			SE 401670 B	22-05-1978
			SU 743575 A	25-06-1980
			US 4249929 A	10-02-1981
			YU 277473 A	28-02-1982
			ZA 7308235 A	25-09-1974
<hr/>				
US 5131746	A	21-07-1992	DE 69226317 D	27-08-1998
			DE 69226317 T	25-03-1999
			EP 0531468 A	17-03-1993
			WO 9213258 A	06-08-1992
<hr/>				
EP 0501682	A	02-09-1992	US 5339254 A	16-08-1994
			AT 157169 T	15-09-1997
			DE 69221653 D	25-09-1997
			DE 69221653 T	02-04-1998
			JP 5072161 A	23-03-1993
			US 5463321 A	31-10-1995
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EP 0696005	A	07-02-1996	US 5587932 A	24-12-1996

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF RECEIPT OF
RECORD COPY

(PCT Rule 24.2(a))

From the INTERNATIONAL BUREAU

To:

COCKAYNE, Gillian
Marconi Intellectual Property
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

for	PL
12.5 APR 2000	

Date of mailing (day/month/year) 07 April 2000 (07.04.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference P/61767/VISD	International application No. PCT/GB00/00809

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

MARCONI APPLIED TECHNOLOGIES LIMITED (for all designated States except US)
PIKE, Andrew (for US)

International filing date : 06 March 2000 (06.03.00)

Priority date(s) claimed : 05 March 1999 (05.03.99)

Date of receipt of the record copy
by the International Bureau : 23 March 2000 (23.03.00)

List of designated Offices :

AP : GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE

OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

National : AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW

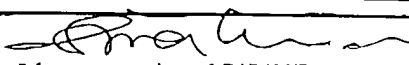
ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase
☐ confirmation of precautionary designations
☒ requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No. (41-22) 740.14.35</p>	<p>Authorized officer:  Mougamadou ABIDINE</p> <p>Telephone No. (41-22) 338.83.38</p>
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ANNEX TO FORM PCT/IB/301

International application No.
PCT/GB00/00809

INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated in the Notification of Receipt of Record Copy (Form PCT/IB/301) by paying national fees and furnishing translations, as prescribed by the applicable national laws.

The time limit for performing these procedural acts is **20 MONTHS** from the priority date or, for those designated States which the applicant elects in a demand for international preliminary examination or in a later election, **30 MONTHS** from the priority date, provided that the election is made before the expiration of 19 months from the priority date. Some designated (or elected) Offices have fixed time limits which expire even later than 20 or 30 months from the priority date. In other Offices an extension of time or grace period, in some cases upon payment of an additional fee, is available.

In addition to these procedural acts, the applicant may also have to comply with other special requirements applicable in certain Offices. **It is the applicant's responsibility** to ensure that the necessary steps to enter the national phase are taken in a timely fashion. Most designated Offices do not issue reminders to applicants in connection with the entry into the national phase.

For detailed information about the procedural acts to be performed to enter the national phase before each designated Office, the applicable time limits and possible extensions of time or grace periods, and any other requirements, see the relevant Chapters of Volume II of the PCT Applicant's Guide. Information about the requirements for filing a demand for international preliminary examination is set out in Chapter IX of Volume I of the PCT Applicant's Guide.

GR and ES became bound by PCT Chapter II on 7 September 1996 and 6 September 1997, respectively, and may, therefore, be elected in a demand or a later election filed on or after 7 September 1996 and 6 September 1997, respectively, regardless of the filing date of the international application. (See second paragraph above.)

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date. If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with an indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.

REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 16-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 16-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity to furnish the priority document within a time limit which is reasonable under the circumstances.

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

PATENT COOPERATION TREATY

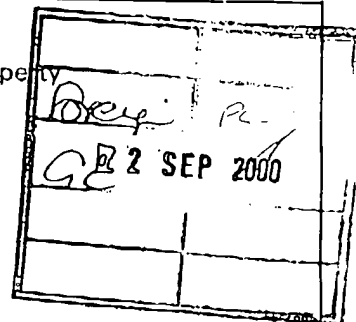
PCT

From the INTERNATIONAL BUREAU

NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

COCKAYNE, Gillian
Marconi Intellectual Property
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

Date of mailing (day/month/year) 14 September 2000 (14.09.00)		
Applicant's or agent's file reference P/61767/VISD		IMPORTANT NOTICE
International application No. PCT/GB00/00809	International filing date (day/month/year) 06 March 2000 (06.03.00)	
Priority date (day/month/year) 05 March 1999 (05.03.99)		
Applicant MARCONI APPLIED TECHNOLOGIES LIMITED et al		

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU, KP, KR, US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE, AL, AM, AP, AT, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EA, EE, EP, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, OA, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 14 September 2000 (14.09.00) under No. WO 00/54045

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

Form PCT/IB/308 (July 1996)

3511782

PATENT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

COCKAYNE, Gillian
Marconi Intellectual Property
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

27 APR 2000

Date of mailing (day/month/year) 18 April 2000 (18.04.00)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference P/61767/VISD	
International application No. PCT/GB00/00809	International filing date (day/month/year) 06 March 2000 (06.03.00)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 05 March 1999 (05.03.99)
Applicant MARCONI APPLIED TECHNOLOGIES LIMITED et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An asterisk (*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
05 Marc 1999 (05.03.99)	9905051.0	GB	03 Apr 2000 (03.04.00)

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer Marc Salzman Telephone No. (41-22) 338.83.38
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PATENT COOPERATION TREATY

PCT

INFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

COCKAYNE, Gillian
Marconi Intellectual Property
Waterhouse Lane
Chelmsford
Essex CM1 2QX
ROYAUME-UNI

Date of mailing (day/month/year) 19 October 2000 (19.10.00)		
Applicant's or agent's file reference P/61767/VISD		IMPORTANT INFORMATION
International application No. PCT/GB00/00809	International filing date (day/month/year) 06 March 2000 (06.03.00)	Priority date (day/month/year) 05 March 1999 (05.03.99)
Applicant MARCONI APPLIED TECHNOLOGIES LIMITED et al		

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

AP : GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE

National : AU, BG, CA, CN, CZ, DE, IL, JP, KP, KR, MN, NO, NZ, PL, RO, RU, SE, SK, US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

OA : BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

National : AE, AL, AM, AT, AZ, BA, BB, BR, BY, CH, CR, CU, DK, DM, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IN, IS, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MW, MX, PT, SD,
SG, SI, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer:

S. Mafla

Facsimile No. (41-22) 740.14.35

Telephone No. (41-22) 338.83.38

Form PCT/IB/332 (September 1997)

3596657

PATENT COOPERATION TREATY

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

COCKAYNE, Gillian
MARCONI INTELLECTUAL PROPERTY
Waterhouse Lane
Chelmsford, Essex CM1 2QX
GRANDE BRETAGNE

GC	PCT
51 NOV 2000	
WRITTEN OPINION	
(PCT Rule 66)	

Date of mailing
(day/month/year) 30.10.2000

Applicant's or agent's file reference

P/61767/VISD

REPLY DUE

within 3 month(s)
from the above date of mailing

International application No.

PCT/GB00/00809

International filing date (day/month/year)

06/03/2000

Priority date (day/month/year)

05/03/1999

International Patent Classification (IPC) or both national classification and IPC

G01N33/00

Applicant

MARCONI APPLIED TECHNOLOGIES LIMITED et al.

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain document cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).


How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the applicant's obligation to consider amendments and/or arguments, see Rule 66.4 bis.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 05/07/2001.

Name and mailing address of the international preliminary examining authority:

 European Patent Office
D-90298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer / Examiner

Stussi, E

Formalities officer (incl. extension of time limits)

Weber, R
Telephone No. +49 89 2399 2382



WRITTEN OPINION

International application No. PCT/GB00/00809

I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*):

Description, pages:

1-11 as originally filed

Claims, No.:

1-26 as originally filed

Drawings, sheets:

1/2-2/2 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been and will not be examined in respect of:

- ☐ the entire international application,
☒ claims Nos. 26,

because:

- ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

WRITTEN OPINION

International application No. PCT/GB00/00809

- ☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 26 are so unclear that no meaningful opinion could be formed (*specify*):

see separate sheet

- ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- ☐ no international search report has been established for the said claims Nos. .

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1,4-6,8,16,24
Inventive step (IS)	Claims 2,3,7,9-15,17-23,25
Industrial applicability (IA)	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/GB00/00809

Comments on Section III

Referring to claim 26, the subject matter for which protection is sought is not defined. The scope of the claim is thus so unclear (Art.6 PCT) that it cannot be examined.

Comments on Section V

1. Reference is made to the following documents:

D1 = US-5 025 653
D2 = J. Mitrovics *et al.*, "Hybrid modular sensor system: a new generation of electronic noses", ISIE '97, Proc. IEEE Int. Symp. on Industrial Electronics, 7-11 July 1997, vol.1, pp.116-121.
D3 = GB-1401556
D4 = US-5131746

2. Claim 1 does not fulfill the requirements of Art.33(2) PCT for the following reasons:

- 2.1 Document D1, which is considered to represent the most relevant state of the art, discloses the following features in combination (references refer to D1):

a chemical sensor system for at- or on-line monitoring of a product or process (col.1, ll.5-9) comprising: sampling means arranged to acquire samples of at least one substance to be sensed from a plurality of different locations (claim 1, ll.60-61); sensor means including an array of sensors arranged to sense the samples (col.5, ll.43-47); and processing means for deriving information from the output of the sensor means concerning the substance or substances to be sensed (col.5, ll.43-47 and col.6, ll.4-7).

- 2.2 The subject matter of claim 1 differs over that of D1 in the fact that the sensor system is applied to a product or process line.
However, this is a feature of the use and not a technical feature of the device. In fact the device disclosed in D1 can as well be used for at or on-line monitoring of a

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/GB00/00809

product or process line.

2.3 Therefore the subject matter of claim 1 is not novel.

3. It is additionally noted that the subject matter of claim 1 also appears not to involve an inventive step (Art. 33(3) PCT) over the combination of documents D2 and D3:

3.1 The subject matter of claim 1 differs over that of D2 in feature that the sampling means are arranged to acquire the at least one substance to be sensed from a plurality of different locations in the product or process line.

3.2 The technical problem to be solved can thus be regarded as: how to check a product (or process) at different stages along the product or process line.

3.3 As to the solution of this problem, it is well known to sample a product (or components of a process) in order to check and possibly control the production or process, cf. e.g. D3, gas probes 11, 12 and 13, or D4, col.1, ll.64. The skilled man would therefore adapt the apparatus of D2 to sampling from different sites whenever it is desired without the exercise of an inventive step.

4. Dependent claims 2-26 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

4.1 Claims 2 and 3 disclose (as far as they can be understood) the two only possible arrangements or the locations (either they are close to each other, or they are not), so the skilled man would unavoidably, and surely without the exercise of an inventive step, come to either of the two configurations.

4.2 The feature of claim 4 is known from D1, cf. e.g. fig. 1 and claim 1. The same objection holds for claims 5 and 6, cf. D1, "sensor housing 18" 12a to 12i, for claim 8, cf. D1, col.6, ll.8-17, for claim 16 and for claim 24 (cf. col.8, first paragraph).

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/GB00/00809

- 4.3 In claim 7 a slight constructional change in the system of claim 1 is defined which comes within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. Consequently, the subject-matter of claim 7 lacks an inventive step. The same objection is valid for claims 10-14 and 19-22.
- 4.4 Referring to claim 9, patter recognition is a well-known and widely applied technique in the field of chemical identification, cf. e.g. D2, p.117, second column, first paragraph. The same objection holds for claim 23, fig.6, temperature and humidity sensors.
- 4.5 In claim 15 several types of sensors are listed, among those usually used in the field of chemical sensing (cf. e.g. sensor modules of D2 and optical sensors of D4). A similar objection holds for claim 18 (as far as it can be understood) for the sampling techniques.
- 4.6 The feature of claim 17 is known from document D2 and the skilled man would apply it to the system of D1 whenever expedient without the exercise of an inventive step.
- 4.7 In claim 25 one of several obvious applications of the system of claim 1 is disclosed.

Comments on Section VII

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 to D4 is not mentioned in the description, nor are these documents identified therein.
2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/GB00/00809

Comments on Section VIII

1. Claims 2 and 3 are unclear (Art.6 PCT) because the terms "remote" and "local" are relative terms which do not provide the reader with any concrete information about the relative arrangements of the locations.
2. Claim 18 is not clear (Art.6 PCT) since many of the possibility mentioned therein do not appear to define sample acquisition methods, e.g.: "portable", "probe" or "ambient monitoring".
3. Claim 25 relates to the use of the system rather than disclosing its further technical features. The subject matter of claim 25 is therefore unclear (Art.6 PCT).

REC'D 21 MAY 2001

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)


Applicant's or agent's file reference P/61767/VISD	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/00809	International filing date (day/month/year) 06/03/2000	Priority date (day/month/year) 05/03/1999
International Patent Classification (IPC) or national classification and IPC G01N33/00		
Applicant MARCONI APPLIED TECHNOLOGIES LIMITED et al.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 8 sheets, including this cover sheet.
 - ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

- This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 22/09/2000	Date of completion of this report 17.05.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Stussi, E Telephone No. +49 89 2399 2265



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/00809

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-11 as originally filed

Claims, No.:

1-26 as originally filed

Drawings, sheets:

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/00809

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 26.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 26 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)

Yes: Claims 2,3,7,9-15,17-23,25

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/00809

	No:	Claims	1,4-6,8,16,24
Inventive step (IS)	Yes:	Claims	
	No:	Claims	2,3,7,9-15,17-23,25
Industrial applicability (IA)	Yes:	Claims	1-25
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Comments on Section III

Referring to claim 26, the subject matter for which protection is sought is not defined. The scope of the claim is thus so unclear (Art.6 PCT) that it cannot be examined.

Comments on Section V

1. Reference is made to the following documents:

D1 = US-5 025 653
D2 = J. Mitrovics *et al.*, "Hybrid modular sensor system: a new generation of electronic noses", ISIE '97, Proc. IEEE Int. Symp. on Industrial Electronics, 7-11 July 1997, vol.1, pp.116-121.
D3 = GB-1401556
D4 = US-5131746

2. Claim 1 does not fulfill the requirements of Art.33(2) PCT for the following reasons:

- 2.1 Document D1, which is considered to represent the most relevant state of the art, discloses the following features in combination (references refer to D1):

a chemical sensor system for at- or on-line monitoring of a product or process (col.1, ll.5-9) comprising: sampling means arranged to acquire samples of at least one substance to be sensed from a plurality of different locations (claim 1, ll.60-61); sensor means including an array of sensors arranged to sense the samples (col.5, ll.43-47); and processing means for deriving information from the output of the sensor means concerning the substance or substances to be sensed (col.5, ll.43-47 and col.6, ll.4-7).

- 2.2 The subject matter of claim 1 differs over that of D1 in the fact that the sensor system is applied to a product or process line.
However, this is a feature of the use and not a technical feature of the device. In fact the device disclosed in D1 can as well be used for at or on-line monitoring of a

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00809

product or process line.

2.3 Therefore the subject matter of claim 1 is not novel.

3. It is additionally noted that the subject matter of claim 1 also appears not to involve an inventive step (Art. 33(3) PCT) over the combination of documents D2 and D3:

3.1 The subject matter of claim 1 differs over that of D2 in feature that the sampling means are arranged to acquire the at least one substance to be sensed from a plurality of different locations in the product or process line.

3.2 The technical problem to be solved can thus be regarded as: how to check a product (or process) at different stages along the product or process line.

3.3 As to the solution of this problem, it is well known to sample a product (or components of a process) in order to check and possibly control the production or process, cf. e.g. D3, gas probes 11, 12 and 13, or D4, col.1, ll.64. The skilled man would therefore adapt the apparatus of D2 to sampling from different sites whenever it is desired without the exercise of an inventive step.

4. Dependent claims 2-26 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

4.1 Claims 2 and 3 disclose (as far as they can be understood) the two only possible arrangements or the locations (either they are close to each other, or they are not), so the skilled man would unavoidably, and surely without the exercise of an inventive step, come to either of the two configurations.

4.2 The feature of claim 4 is known from D1, cf. e.g. fig.1 and claim 1. The same objection holds for claims 5 and 6, cf. D1, "sensor housing 18" 12a to 12i, for claim 8, cf. D1, col.6, ll.8-17, for claim 16 and for claim 24 (cf. col.8, first paragraph).

- 4.3 In claim 7 a slight constructional change in the system of claim 1 is defined which comes within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. Consequently, the subject-matter of claim 7 lacks an inventive step. The same objection is valid for claims 10-14 and 19-22.
- 4.4 Referring to claim 9, patten recognition is a well-known and widely applied technique in the field of chemical identification, cf. e.g. D2, p.117, second column, first paragraph. The same objection holds for claim 23, fig.6, temperature and humidity sensors.
- 4.5 In claim 15 several types of sensors are listed, among those usually used in the field of chemical sensing (cf. e.g. sensor modules of D2 and optical sensors of D4). A similar objection holds for claim 18 (as far as it can be understood) for the sampling techniques.
- 4.6 The feature of claim 17 is known from document D2 and the skilled man would apply it to the system of D1 whenever expedient without the exercise of an inventive step.
- 4.7 In claim 25 one of several obvious applications of the system of claim 1 is disclosed.

Comments on Section VII

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 to D4 is not mentioned in the description, nor are these documents identified therein.
2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00809

Comments on Section VIII

1. Claims 2 and 3 are unclear (Art.6 PCT) because the terms "remote" and "local" are relative terms which do not provide the reader with any concrete information about the relative arrangements of the locations.
2. Claim 18 is not clear (Art.6 PCT) since many of the possibility mentioned therein do not appear to define sample acquisition methods, e.g.: "portable", "probe" or "ambient monitoring".
3. Claim 25 relates to the use of the system rather than disclosing its further technical features. The subject matter of claim 25 is therefore unclear (Art.6 PCT).



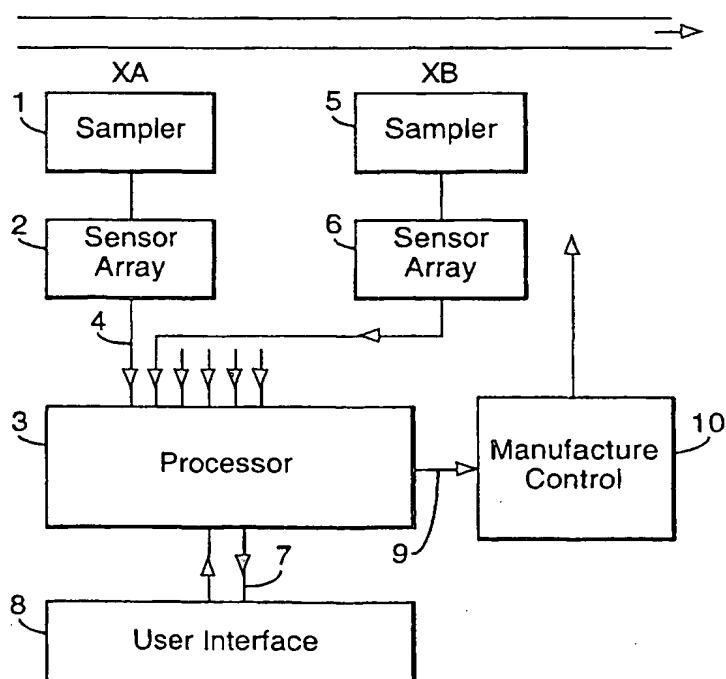
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : G01N 33/00		A1	(11) International Publication Number: WO 00/54045
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(21) International Application Number: PCT/GB00/00809 (22) International Filing Date: 6 March 2000 (06.03.00) (30) Priority Data: 9905051.0 5 March 1999 (05.03.99) GB (71) Applicant (for all designated States except US): MARCONI APPLIED TECHNOLOGIES LIMITED [GB/GB]; One Bruton Street, London W1X 8AQ (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): PIKE, Andrew [GB/GB]; 39 Hunts Drive, Writtle, Chelmsford, Essex CM1 3HQ (GB). (74) Agent: COCKAYNE, Gillian; Marconi Intellectual Property, Waterhouse Lane, Chelmsford, Essex CM1 2QX (GB).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report.	

(54) Title: CHEMICAL SENSOR SYSTEMS

(57) Abstract

In a chemical sensor system, samples are taken at multiple locations and then processed at a single processor module to give at or on line monitoring of a product or process.



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Chemical Sensor Systems

This invention relates to chemical sensor systems, and more particularly for at- or on-line monitoring of a product or process.

5 Chemical sensor array systems for sensing in the liquid, gas or vapour phase, including as a sub-class those arrays sometimes referred to as electronic noses as they operate using odour analysis, have been successfully employed in laboratory instruments for the measurement of headspace volatiles. Typical applications include quality control of raw materials and final product, new product development and correlation with sensory panel
10 data. Those instruments developed to date have primarily aimed at laboratory use.

In applications where substances are being handled or modified during manufacture or processing, there are typically several stages during the process where there is a requirement for assessment of quality, authenticity and/or compositional property of a substance.
15 Chemical sensor array systems (SAT) may be used in assessing these characteristics.

The present invention seeks to provide a chemical sensor system which is particularly suitable for at-line or on-line monitoring.

20 According to the invention, there is provided a chemical sensor system for at or on-line monitoring of a product or process comprising: sampling means arranged to acquire samples of a substance to be sensed from a plurality of different locations in the product or process line; sensor means including an array of sensors arranged to sense the samples; and

processing means for deriving information from the output of the sensor means concerning the substance or substances to be sensed.

As used in this specification, "at-line" means that a monitoring instrument is located next to the detection point of interest, from which a sample may be introduced either manually or by automated means. Analysis of the product or process is achieved from a discrete sample or batched samples. The term "on-line" is defined to mean that there is a physical connection between the monitoring system and the detection point, which allows the product or process to be monitored by discrete samples, batched samples or continuously with automated sampling. "In-line" systems are a subset of on-line systems.

By using the invention, it is possible to analyse samples of substances from different locations in a product or process line and to assess them together within the process system as a whole or to assess samples individually. This would, for instance, provide a means of monitoring at several stages during a production process. The substance sampled at a plurality of different locations may be nominally the same substance or it could be another substance introduced, modified or generated during a production process. More than one substance may be sensed at a single location to give a more complete characterisation of the manufacturing or process line.

The advantage of using monitoring technology in an at-line or on-line configuration is that it enables 'point of use' or in-situ measurement of a sample which in turn allows real-time monitoring of a product or process. A process to be monitored may involve one or more physical or chemical procedures used in the treatment, conversion or manufacture of an

intermediate or final product. In a manufacturing environment at- or in-line monitoring allows rapid corrective action to be taken if there has been a deviation from normal or acceptable performance or quality in product or process. The delay in taking a sample for remote off-line analysis in a laboratory-based instrument is often unacceptable. At and on-line monitoring is therefore preferable in many areas of industry and also in environments
5 where the system is monitoring for hazardous conditions e.g. fire or generation of toxic vapours.

The sampling means may be incorporated as part of the sensor means, with sensors of the sensor means being placed at a detection point of interest. The sampling means might
10 alternatively be discrete from the sensor means. Examples of the sample means are arrangements using at least one of the following techniques to acquire a sample: portable; liquid headspace; liquid sparge; sample vaporisation; a probe; solid head space; direct insertion of an array of liquid phase chemical sensors into the sample or sample stream; gas line and ambient monitoring. For a particular system, it is necessary to select a sample
15 handling technique appropriate to the substance to sensed.

A sample handling apparatus extracting a sample from a liquid head space is suitable for monitoring ambient volatiles above a liquid sample. Liquid sparge comprises flushing a liquid sample with inert gas to release volatiles. A probe may comprise, for example, a
20 flexible tube and pump to acquire a sample. In a solid head space, ambient volatiles are monitored above a solid sample. A gas line might be used in which a sample is drawn off from a gas stream, this being particularly suitable for processes involving fermentation. A sample handling module may use an ambient technique such as passive monitoring of the

local environment, for example, for fire detection. Other techniques may be appropriate for other applications. Where a sample is to be monitored in the liquid phase a sensor array may be inserted into the sample or sample stream.

The sample handling means may be such as to acquire a sample without operator
5 intervention to give an automated procedure, and samples may be taken at discrete time intervals which are fixed or variable, or continuously. Also, switching between discrete, batched and continuous sampling may take place depending on the particular time in a production process, location from which the sample is taken or for some other reason.

10 In one system, the sampling apparatus includes means to introduce a calibration or reference sample. Alternatively, this may be provided at the sensor means. This allows calibration or checking of the sensor array performance.

The distributed chemical sensor system may provide information concerning the
15 operation of a production line or a process which can then be used in a control feedback system, in which data generated by the system is fed back to determine the settings of control hardware, for example, in a System Control and Data Acquisition (SCADA) system. Feedback may also be provided to the monitoring system itself, for example, to adjust sensor settings or sampling frequency.

20 In one embodiment of the invention, the sensor means comprises a plurality of sensor arrays located at respective different locations. This minimizes the path to be taken between the sampling means and sensor means, where these are separately housed, as each sensor

array module may be located at the detection point at which the sample is acquired.

In a chemical sensor, a change in a physical property, such as a change in electrical conductivity, is produced in response to a gas or vapour being sensed. Many different sensor technologies are available for use in the sensor means. Advantageously, the sensor means
5 includes a sensor array using at least one of the following types of sensor technology: mass sensitive sensor; electronic conductance or capacitance sensors; field effect sensors; calorimetric sensors; electrochemical sensors (for example, amperometric, potentiometric or conductimetric sensors); optochemical or photometric sensors; and biosensors. In fact any sensor which produces a useful output corresponding to a change in characteristic when a
10 chemical is sensed may be suitable. Mass sensitive sensors may be for example those using bulk acoustic wave or surface acoustic wave techniques. Electronic conductance and capacitance sensors may be for example chemo-resistors based on conducting polymer or metal oxide semiconductor materials. Calorimetric sensors may for example be pellistors. Electrochemical sensors are for example potentiometric cells. Infra red and fibre optic based
15 techniques may be used in optochemical or photometric sensors. Biosensor and electrochemical sensors may be particularly suitable for liquid phase sensing.

A system in accordance with the invention may include a sensor array having sensors of one technology type only. In that case, the sensor environment can be specifically tailored
20 for use with sensors of that type. In alternative arrangements, the sensor array includes sensors of a combination of different technology types. This gives increased sensitivity and/or discrimination in some cases, the particular combination being tailored to the substance to be sensed. Several sensor arrays of differing technology types or different



combinations of technology types may be included in a system.

The processing means may be arranged to simultaneously accept information relating to samples acquired from respective different locations or to obtain such information sequentially. The information obtained from the samples taken at different points may individually be used to give an assessment of the state of the product or process on-line or they may be used in combination. Thus, the processing means may classify substances at individual locations or classify the status of the line as a whole.

Preferably, the processing means uses pattern recognition to characterise the substance. The pattern recognition technique used in the processing module may use at least one of the following: a statistical method (for example, principal component analysis (PCA), or multiple discriminant analysis (MDA)); fuzzy logic; an artificial neural network; and a proprietary classifier algorithm. The technique or techniques adopted depend on the substance to be sensed and the use made by the system of information acquired via the monitoring procedure.

Some ways in which the invention may be performed are now described by way of example with reference to the accompany drawings in which:

Figure 1 schematically illustrates a chemical sensor system in accordance with the present invention; and

Figures 2, 3 and 4 relate to another chemical sensor system in accordance with the invention.

With reference to Figure 1, a chemical sensor array system is used to monitor a product manufactured by a process including several processing steps. In this case it is wished to monitor the composition of a substance at various points in the processing method to assess the effectiveness of the process line. The monitoring system includes a sampler 1 at a first point A at which a sample of the substance is extracted using an appropriate sampling technique. In this case, a sample is taken at fixed timing intervals. The container in which the sample is housed is connected via a pipe to a sensor array module 2 in such a way that volatiles existing in the headspace above the solid sample are transferred over sensors of the array. The output of the sensors is determined by their response to the volatiles to which they are exposed. In this case, the sensor array module 2 combines a plurality of different sensor technologies providing a set of signal outputs characteristic of the substance of the sample. A central processor 3 accesses the outputs of the sensor array module 2 via a fixed link 4 to provide a series of data points characteristic of the sample being sent. Pre-processing occurs in the central processor 3 to place the acquired data in a form suitable for pattern recognition techniques to be applied thereto.

A second sampler 5 is arranged to take samples downstream of location A at a second location B at which stage it is expected that the substance being processed has been modified. A sample is taken by the sample handling means 5 in a way appropriate to the form of the substance and the most appropriate types of sensor technology to detect changes in its physical or chemical characteristics. The sample is presented to a second sensor array module

6 which is located locally to the sample handling means 5. The second sensor array module 6 produces a set of responses characteristic of the composition of the substance being sampled. These are also accessed by the central processor 3. Additional samples may be taken at other points of detection in the process line. These points of detection may be down-stream of the first one or could be at locations A and B but arranged to take samples of different substances.

The central processor 3 is arranged to apply a suitable pattern recognition technique to the data required from the second sensor array module 6. The processor 3 then assesses the data derived from each sensor array module in turn to characterise the substance sampled at the point of detection associated with that sensor array module. In addition, the central processor 3 provides an overview of the production line as a whole to characterise the entire process system.

The information which results from the processing stage is then applied by a link 7 to a user interface 8, which in this case takes the form of a visual display from which an operator may view the performance of the system. In addition, the user interface 8 permits the operator to input control data, for example, to vary the frequency at which samples are taken, control characteristics of sensors in the sensor array modules 2 or 6 or to implement different functions of the central processor 3. Other changes to the monitoring system may be arranged to be implemented or automatically via the central processor 3. For example, if the central processor 3 detects rapid changes in characteristics of a set of samples, it may send control signals to the sample means to increase the rate at which samples are taken.



The central processor 3 is also linked via line 9 to a manufacture control system 10 which utilises the information acquired from the monitoring system to adjust the parameters of the process line in dependence on any detected variations from the sample composition from the desired characteristics.

5 The central processor 3 may be set up so that it is able to acquire data communicated from either a single sensor array module or from several and place them into a form which is suitable for further processing. A pattern recognition technique may be applied to each sensor array module in turn or to a plurality of sensor array modules simultaneously.

10 Another system in accordance with the invention is illustrated in Figure 2. This system is used in the monitoring of waste water from a chemical plant. Samples are taken at three locations XA, XB and XC via samplers 11, 12 and 13 each of which is associated with its own sensor module 14, 15 and 16. The outputs of the sensor modules 14, 15 and 16 are connected via a bus arrangement 17 to a processing module 18. A user interface 19 is
15 integrated into the same enclosure 20 as the processing module 18. A schematic diagram of the enclosure 20 is illustrated in Figure 3.

The processor elements of the module 18 comprise a single board computer (SBC) 21 and a hard-drive 22 to provide additional memory. The user interface includes a flat panel
20 display 23 and a keypad 24 that are mounted on the front of the enclosure 20. The software to acquire and control the system is run on a DOS operating system installed on the Single Board Computer 21. The setup and operation of the system is menu driven via the software, visible on the display 23. Buttons on the keypad 24 are used to select menu items. The SBC

21 is connected to sensor modules 14, 15 and 16 via an asynchronous RS 485 multi-drop serial data link. A power supply unit (psu) 25 is also included in enclosure 20.

One of the sensor modules 14 is illustrated in Figure 4 and includes means for transmitting and receiving data and control signals from the processor module 18. It contains an array 26 of chemical sensors which is in a temperature controlled housing 27 that allows samples to pass over the sensors. In some sensor modules the flow and relative humidity (RH) are also measured. Other parameters relating to sensor operation are also controlled. All the sensor and control hardware 30 require interface electronics 28 to make them compatible with the input/outputs of a microcomputer 29. The microcomputer 29 acquires sensor data and transmits the data over the RS 485 connection to the processor 18 via a driver IC 31. The RS 485 driver IC 31 is required to interface the signals over the data communications bus 17 to the microcomputer 29. Data is collected, processed and transmitted to the processor module 18. The other sensor modules 15 and 16 are similarly configured.

Both the microcomputer 29 in the sensor module 14 and the SBC 21 in the processor 18 adhere to the same interface protocol. In this instance, the data link is 19,200 baud, and the data mode is 8 data bits, 1 stop bit, even parity. This can be reconfigured for different applications.

The SBC 21 will communicate with a sensor module 14, 15 or 16 via a number of commands e.g. idle mode, acquire data, cleanup mode, diagnostics. Other commands relating to changing the setup of the sensor module may also be sent. A sensor module may send a reply to the SBC 21 to inform that the message has been received and understood. Each sensor

module has a unique identifying number that is used by the SBC to identify the recipient of a command. Since the RS 485 bus is multi-drop, a number of units can be connected to the same pair of wires. Normally, communication will be with one sensor module at a time, but certain commands can be sent to all sensor modules at once by use of a global identifier.

When data is transmitted from the sensor module to the SBC, data relating to the identity of the sensor module is attached. In one mode of operation each sensor module is polled in turn by the processor module to avoid message collision.

An application that can benefit from this invention is a process plant that has its effluent monitored in order that its chemical composition does not exceed levels set by environmental agencies. At these sites there are typically multiple sources of effluent, which are connected together to form a single drain off site. A sensor module can be installed at each of the sources of effluent using a suitable sampling technique. By collecting the entire chemical sensor data at the processor unit across the data link, it provides a profile of the quality of effluent water across the whole site. This information can be used to control the diversion of polluted water into temporary storage to prevent chemical content levels being exceeded off the site.

Other applications include processes where batches are blended to attain a final product of uniform quality.

CLAIMS

1. A chemical sensor system for at- or on-line monitoring of a product or process comprising:
sampling means arranged to acquire samples of at least one substance to be sensed from a
5 plurality of different locations in the product or process line; sensor means including an array
of sensors arranged to sense the samples; and processing means for deriving information from
the output of the sensor means concerning the substance or substances to be sensed.
2. A system as claimed in claim 1 wherein locations at which the samples are taken are
10 remote from one another.
3. A system as claimed in claim 1 or 2 wherein locations at which the samples are taken are
local to one another.
- 15 4. A system as claimed in claim 1, 2 or 3 wherein the sensor means comprises a plurality of
sensor arrays located at respective different locations.
5. A system as claimed in claim 4 wherein the sensor arrays are housed in separate modules.
- 20 6. A systems as claimed in any preceding claim wherein sampling means and sensor means
are housed in a common module.
7. A system as claimed in any preceding claim wherein the processing means is arranged to



acquire simultaneously information relating to samples acquired from respective different locations.

8. A system as claimed in any of claims 1 to 6 wherein the processing means is arranged to acquire sequentially information relating to samples acquired from respective different

5 locations.

9. A system as claimed in any preceding claim wherein processing means is arranged to apply pattern recognition to data relating to the samples.

10 10. A system as claimed in any preceding claim and including a user interface.

11. A system as claimed in any preceding claim and including means for deriving signals to control the product or process line in dependence on the samples sensed.

15 12. A system as claimed in any preceding claim and including means for controlling the sampling means and/or sensor means in dependence on information derived from the samples sensed.

13. A system as claimed in any preceding claim wherein the processing means provides
20 control signals to the sensor means.

14. A system as claimed in any preceding claim wherein the sensor means comprises at least one sensor array module which includes sample handling capability.



15. A system as claimed in any preceding claim wherein the sensor means includes at least one of the following types of sensor technology: mass sensitive sensors; electronic conductance or capacitance sensors; field effect sensors; calorimetric sensors; electrochemical sensors; optochemical or photometric sensors; and biosensors.

5 16. A system as claimed in any preceding claim wherein the sensor means includes sensors of only one sensor technology type.

17. A system as claimed in any of claims 1 to 15 wherein the sensor means includes sensors of a combination of different technology types.

10

18. A system as claimed in any preceding claim wherein the sampling means uses at least one of the following techniques to acquire a sample: portable; liquid headspace; liquid sparge; sample vapourisation; a probe; solid head space; direct insertion of an array of liquid phase chemical sensors into the sample or sample stream; gas line and ambient monitoring.

15

19. A system as claimed in any preceding claim and including a bus connecting a plurality of sensor arrays to the processing means.

20

20. A system as claimed in any preceding claim wherein the processing means is connected to the sensor means via an asynchronous multi-drop serial data link.

21. A system as claimed in any preceding claim wherein the processing means is arranged to poll in turn sensor arrays included in the sensor means.

22. A system as claimed in any preceding claim wherein the processing means includes a single board computer, a hard drive and a user interface display.

23. A system as claimed in any preceding claim and including a relative humidity sensor.

5 24. A system as claimed in any preceding claim and wherein data transmitted from a sensor array includes an identification number identifying that array.

25. A system as claimed in any preceding claim in which samples of effluent from a chemical processing plant are monitored at different locations.

10

26. A chemical sensor system for at- or on-line monitoring of a product or process substantially as illustrated in and described with reference to the accompanying drawing.

1/2

Fig.1.

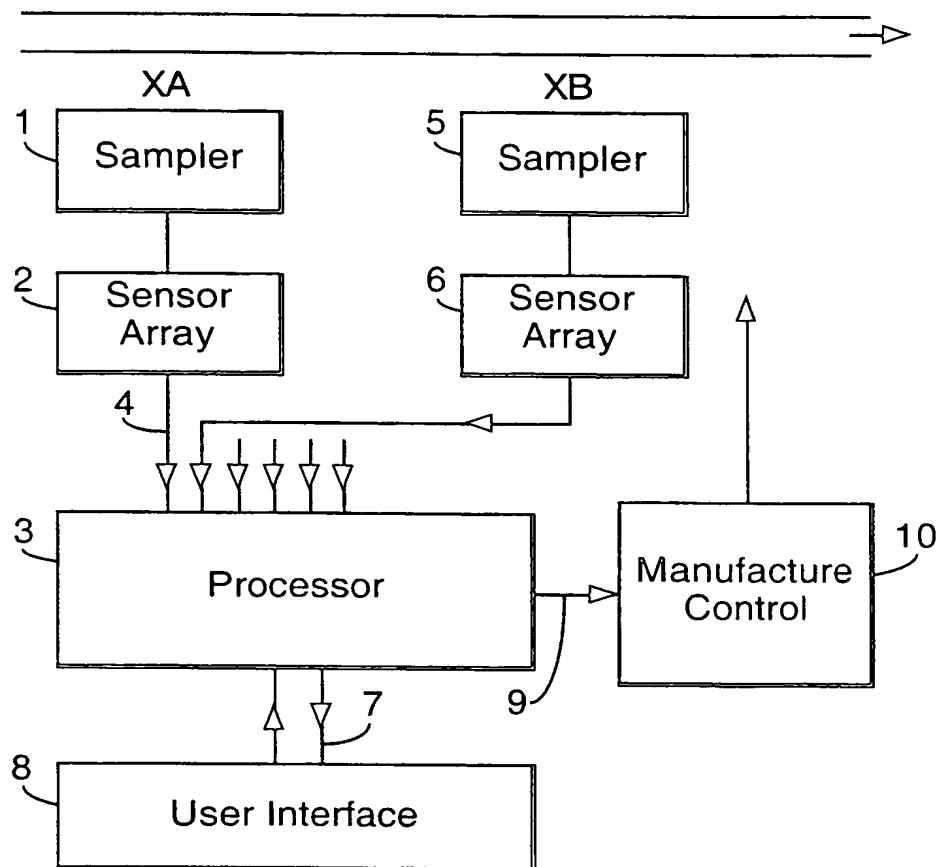


Fig.2.

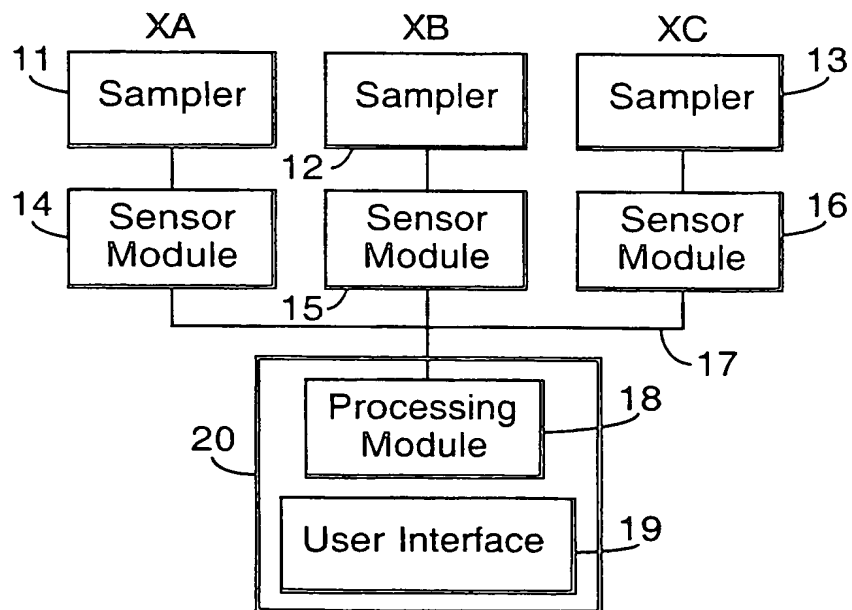


Fig.3.

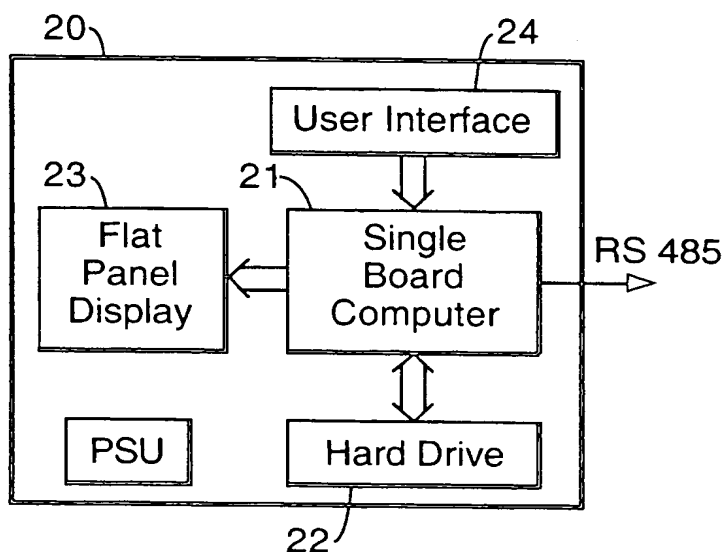
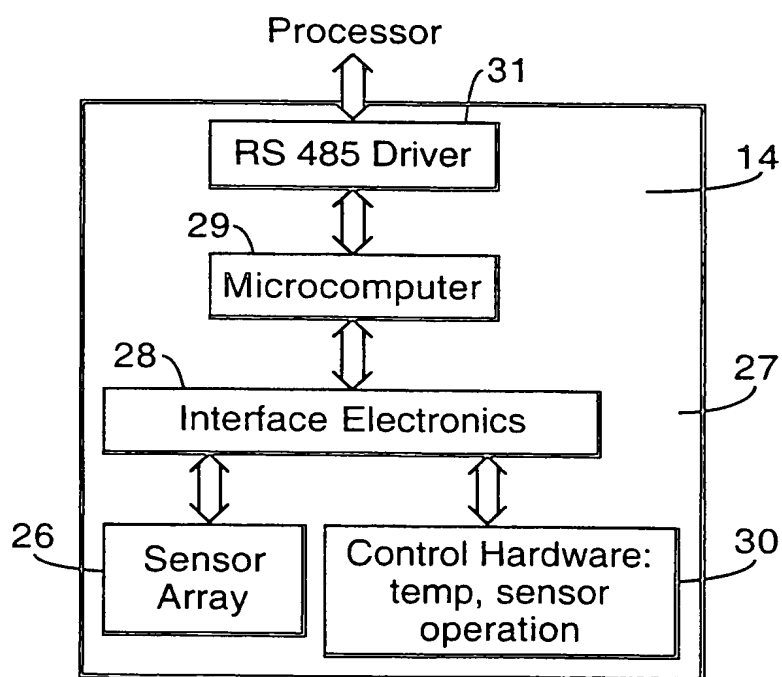


Fig.4.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/00809

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G01N33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	claim 1 ----- -/-	9,15,17, 18

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No

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